

SIDEBAR

Sidebar: Rapid Innovation and the Development of the COVID-19 Vaccine

Epidemiologists, doctors, and other scientists worked under extreme time pressure to develop, test, and produce effective vaccines for COVID-19. The contributions of globally recognized universities, government agencies, nonprofit initiatives, and pharmaceutical companies demonstrate the kind of rapid action and knowledge sharing that can take place in emergency situations like the pandemic.

The medical and scientific achievements related to the pandemic were possible due to decades of federally and privately funded research. For more than 50 years, scientists have studied the family of coronaviruses circulating among livestock and poultry that have demonstrated the ability to jump from their original host animals to humans. In the past two decades, members of this coronavirus family that have jumped to humans have caused outbreaks of severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS), and the current coronavirus disease (COVID-19). After the emergence of SARS in 2002 and MERS in 2012, coronavirus research expanded significantly. Research on the coronaviruses that cause SARS and MERS provided a stock of knowledge available to scientists, including data on the structure, genome, and life cycle of this family of coronaviruses, when the SARS-CoV-2 virus that causes COVID-19 emerged in December 2019.

The World Health Organization's declaration of a pandemic in March 2020 has led to even more research on coronaviruses and COVID-19 specifically. By October 2020, more than 3,600 trials about COVID-19 had been conducted or were still ongoing; most of these were clinical trials for COVID-19 treatments (OECD 2021). The COVID-19 pandemic has also spurred a large increase in scientific publications, with more than 175,000 articles related to COVID-19 published on PubMed, a resource sharing biomedical and life sciences literature, by September 2021 (NIH 2021). See the *Indicators* report "[2022] Publications Output: U.S. Trends and International Comparisons" for more information on how scientific publication output has changed during the pandemic.

With regard to vaccine development, as of September 2021, there were 114 COVID-19 vaccines in clinical development, including some that were in the development phase at the outset of the pandemic. These vaccine candidates utilize ten different technology platforms, one of which is mRNA-based vaccine technology (World Health Organization 2021). The research underpinnings of mRNA vaccines date back to 1989 (Malone, Felgner, and Verma 1989). In 2005, researchers at the University of Pennsylvania solved a key technical barrier to the use of mRNA in vaccine or drug applications (Karikó et al. 2005), and several biotechnology and pharmaceutical firms, including BioNTech and Moderna, licensed their work hoping to develop marketable pharmaceuticals. Prior to the emergence of SARS-CoV-2, these efforts were largely unsuccessful in bringing products to market. However, all of this work on mRNA technology was useful; it provided knowledge and technologies that enabled researchers to quickly develop mRNA vaccines for SARS-CoV-2. On December 2, 2020, less than a year after COVID-19 was declared a pandemic, the United Kingdom's Medicines and Healthcare Products Regulatory Agency granted temporary regulatory approval for the Pfizer-BioNTech mRNA vaccine, making the United Kingdom the first country in the world to approve an mRNA-based vaccine for use in humans (Lamb 2021).